CLAIMS

WE CLAIM:

1. A system for aligning a sample comprising:

a pivot mounted stage/sample;
a means for imparting translation motion to said pivot mounted stage/sample substantially along a perpendicular to a surface thereof;
a first source of a first beam of electromagnetic radiation in functional combination with a multi-element alignment detector comprised of at least two detector elements surrounding a hole therethrough;
and
a second source of a second beam of electromagnetic radiation; and
a data detector;

said first source of a first beam of electromagnetic radiation being oriented so as to provide a first beam of electromagnetic radiation through said hole in said multi-element alignment detector;

said pivot mounted stage/sample being positioned to receive said first beam of electromagnetic radiation substantially along a normal to a surface of said pivot mounted stage/sample via said hole in said multi-element alignment detector;

said second source of electromagnetic radiation being positioned to provide a beam of electromagnetic radiation and direct it to the surface of said sample at an oblique angle thereto, such that

said second beam of electromagnetic radiation reflects from said surface of said pivot mounted stage/sample;

said first and second electromagnetic beams being oriented with respect to one another at a known angle;

said pivot mounted stage/sample being mounted to said means for imparting translation motion such that said pivot mounted stage/sample can be caused to move substantially along a perpendicular to the surface thereof, such that the reflected second beam of electromagnetic radiation enters said data detector.

2. A method of aligning a sample comprising the steps of:

a) providing a pivot mounted stage/sample; and
a means for imparting translation motion to said pivot mounted stage/sample substantially along a perpendicular to a surface thereof;
a first source of a first beam of electromagnetic radiation in functional combination with a multi-element alignment Detector comprised of at least two detector elements surrounding a hole therethrough; and
a second source of a second beam of electromagnetic radiation; and
a data detector;

said first source of a first beam of electromagnetic radiation being oriented so as to provide a first beam of electromagnetic radiation through a hole in said multi-element alignment detector;

said pivot mounted stage/sample being positioned to receive said first beam of electromagnetic radiation substantially along a

normal to a surface of said pivot mounted stage/sample via said hole in said multi-element alignment detector;

said second source of a second beam of electromagnetic radiation being oriented such that a beam of electromagnetic is provided thereby at an oblique angle to the surface of said sample;

said first and second electromagnetic beams being oriented with respect to one another at a known angle;

b) causing a first beam of electromagnetic radiation from said first source of a first beam of electromagnetic to pass through said hole in the multi-element alignment detector such that said first beam of electromagnetic radiation reflects from the surface of said pivot mounted stage/sample;

c) pivoting said sample about said stage/sample pivot mounting until signals from all of the detector detector elements in the multi-element alignment detector are substantially minimized or equalized, indicating that said first beam of electromagnetic radiation approaches said surface of said sample substantially along a normal thereto;

d) causing said second source of electromagnetic radiation to provide a beam of electromagnetic radiation and direct it to the surface of said sample at an oblique angle thereto, such that said second beam of electromagnetic radiation reflects from said surface of said pivot mounted stage/sample;

e) optionally causing said pivot mounted stage/sample to undergo translation motion substantially perpendicular to the surface of said sample via said means for imparting translation

motion to said pivot mounted stage/sample;

such that the reflected second beam of electromagnetic radiation is directed to enter said data detector.

3. A method of aligning a sample as in Claim 2, wherein the steps c. and e. are automated.

4. A method of aligning a sample as in Claim 2, which comprises repeating the method at another location on the sample.

5. A method of aligning a sample as in Claim 2, wherein the multi-element alignment detector is a quad detector comprising four detector elements.

6. A system for aligning a sample comprising:

a pivot mounted stage/sample;
a means for imparting translation motion to said pivot mounted stage/sample substantially along a perpendicular to a surface thereof;
a first source of a first beam of electromagnetic radiation in functional combination with a beam splitter and a multi-element alignment detector comprised of at least two detector elements; and
a second source of a second beam of electromagnetic radiation; and
a data detector;

said first source of a first beam of electromagnetic radiation being oriented so as to transmit a first beam of electromagnetic radiation through said beam splitter;

said pivot mounted stage/sample being positioned to receive said

first beam of electromagnetic radiation substantially along a normal to a surface of said pivot mounted stage/sample via said beam splitter;

said multi-element alignment detector being positioned to receive electromagnetic radiation reflected from said surface of said sample which is reflected from said beam splitter;

said second source of electromagnetic radiation being positioned to provide a beam of electromagnetic radiation and direct it to the surface of said sample at an oblique angle thereto, such that said second beam of electromagnetic radiation reflects from said surface of said pivot mounted stage/sample;

said first and second electromagnetic beams being oriented with respect to one another at a known angle;

said pivot mounted stage/sample being mounted to said means for imparting translation motion such that said pivot mounted stage/sample can be caused to move substantially along a perpendicular to the surface thereof, such that the reflected second beam of electromagnetic radiation enters said data detector.

7. A method of aligning a sample comprising the steps of:

a) providing a system for aligning a sample comprising:

a pivot mounted stage/sample;
a means for imparting translation motion to said pivot mounted stage/sample substantially along a perpendicular to a surface thereof;
a first source of a first beam of electromagnetic

radiation in functional combination with a beam splitter and a multi-element alignment detector comprised of at least two detector elements; and

a second source of a second beam of electromagnetic radiation; and

a data detector;

said first source of a first beam of electromagnetic radiation being oriented so as to transmit a first beam of electromagnetic radiation through said beam splitter;

said pivot mounted stage/sample being positioned to receive said first beam of electromagnetic radiation substantially along a normal to a surface of said pivot mounted stage/sample via said beam splitter;

said multi-element alignment detector being positioned to receive electromagnetic radiation reflected from said surface of said sample which is reflected from said beam splitter;

said second source of electromagnetic radiation being positioned to provide a beam of electromagnetic radiation and direct it to the surface of said sample at an oblique angle thereto, such that said second beam of electromagnetic radiation reflects from said surface of said pivot mounted stage/sample;

said first and second electromagnetic beams being oriented with respect to one another at a known angle;

said pivot mounted stage/sample being mounted to said means for imparting translation motion such that said pivot mounted stage/sample can be caused to move substantially along a perpendicular to the surface thereof, such that the reflected second beam of electromagnetic radiation enters said data

detector;

b) causing a first beam of electromagnetic radiation from said first source of a first beam of electromagnetic to pass through said beam splitter such that said first beam of electromagnetic radiation reflects from the surface of said pivot mounted stage/sample, then reflects from said beam splitter and enters said multi-element alignment detector;

c) pivoting said sample about said stage/sample pivot mounting until signals from all of the multi-element alignment detector detector elements are substantially minimized or equalized, indicating that said first beam of electromagnetic radiation approaches said surface of said sample substantially along a normal thereto;

d) causing said second source of electromagnetic radiation to provide a second beam of electromagnetic radiation and direct it to the surface of said sample at an oblique angle thereto, such that said second beam of electromagnetic radiation reflects from said surface of said pivot mounted stage/sample;

e) optionally causing said pivot mounted stage/sample to undergo translation motion substantially perpendicular to the surface of said sample via said means for imparting translation motion to said pivot mounted stage/sample;

such that the reflected second beam of electromagnetic radiation is directed to enter said data detector.

8. A method of aligning a sample as in Claim 7, wherein the steps c. and e. are automated.

9. A method of aligning a sample as in Claim 7, which comprises repeating the method at another location on the sample.

10. A method of aligning a sample as in Claim 7, wherein the multi-element alignment detector is a quad detector comprising four detector elements.

11. A system as in Claim 1 in which the multi-element alignment detector is a quad detector comprising four detector elements.

12. A system as in Claim 6 in which the multi-element alignment detector is a quad detector comprising four detector elements.

13. A method of aligning a sample as in Claim 2 in which the first and beams of electromagnetic radiation from the first and second sources of electromagnetic radiation to both impinge on the sample surface at substantially the same spot.

14. A method of aligning a sample as in Claim 3 in which the first and beams of electromagnetic radiation from the first and second sources of electromagnetic radiation to both impinge on the sample surface at substantially the same spot.

15. A method of aligning a sample as in Claim 7 in which the first and beams of electromagnetic radiation from the first and second sources of electromagnetic radiation both impinge on the sample surface at substantially the same spot.

16. A method of aligning a sample as in Claim 2 in which the first and beams of electromagnetic radiation from the first and second sources of electromagnetic radiation impinge on the sample surface at different locations.

17. A method of aligning a sample as in Claim 3 in which the

first and beams of electromagnetic radiation from the first and second sources of electromagnetic radiation impinge on the sample surface at different locations.

18. A method of aligning a sample as in Claim 7 in which the first and beams of electromagnetic radiation from the first and second sources of electromagnetic radiation impinge on the sample surface at different locations.

19. A system for aligning a sample system and controlling the angle and plane of incidence at which a beam of electromagnetic radiation obliqely impinges on a monitored location of a surface of a sample comprising, as viewed in side elevation:

a sample supporting stage which can be translated in "X", "Y" or "Z" directions as well as rotated about "X", "Y" and optionally "Z" axes;

vertically above said stage there being a first beam splitter means, a lens and a first camera means for providing a view of a portion of the surface of said sample, said first beam splitter means optionally having positioned on a lower surface thereof light emitting means for providing light to the surface of said sample;

laterally with respect to said first beam splitter means there being a reflection means;

vertically above said reflection means there being a second beam splitter;

vertically above said second beam splitter there being a second camera means and laterally with respect to said second beam splitter, there being sequentially a lens and an essentially

point source of electromagnetic radiation;

said first and second camera means each having associated therewith display means;

said system further comprising an ellipsometer polarization state generator to cause, and a polarization stage detector to monitor, a beam of electromagnetic radiation which in use impinges on said monitored location on said surface of said sample at an oblique angle thereto;

such that in use said first camera means and its associated display means provide a view of at least a portion of the surface of a sample utilizing light provided by said light emitting means for providing light to the surface of said sample positioned on said lower surface of said first beam splitter, and said essentially point source of electromagnetic radiation provides electromagnetic radiation to the surface of said sample via said second beam splitter, said reflective means and said first beam splitter;

and said sample supporting stage is caused to be translated in any of said "X", "Y" and "Z" directions as well as rotated about said "X", "Y" and optionally "Z" axes which are necessary to cause an interrogating beam of electromagnetic radiation provided by said essentially point source of electromagnetic radiation to reflect from the surface of said sample, proceed back through said first beam splitter means, reflect from said reflective means, pass through said second beam splitter means, enter said second camera means and cause an image on the display means associated therewith which indicates that the monitored location on the sample surface is oriented so as to face substantially vertically;

the purpose being to align said sample surface to assure that said beam of electromagnetic radiation provided to said monitored location on the surface of said sample at an oblique angle approaches said surface at known intended angle of incidence and plane of incidnce orientation, rather than at an angle of incidence and plane of incidence orientation which is modified by surface irregularities or non-flat samples;

said system being functionally characterized by:

a first source of a first beam of electromagnetic radiation in functional combination with a multi-element alignment detector comprised of at least two detector elements surrounding a hole therethrough;

said first source of a first beam of electromagnetic radiation being oriented so as to provide a first beam of electromagnetic radiation through said hole in said multi-element alignment detector such that when said first beam of electromagnetic radiation is directed substantially along a normal to a surface of said sample surface via said hole in said multi-element alignment detector, substantially equal amounts of electromagnetic radiation enter each of the detector elements of said multi-element alignment detector;

said first beam of electromagnetic radiation being oriented at a known angle with respect to said beam of electromagnetic radiation provided to said monitored location on the surface of said sample at an oblique angle.

20. A system for aligning a sample system and controlling the angle and plane of incidence at which a beam of electromagnetic

radiation obliqely impinges on a monitored location of a surface of a sample comprising, as viewed in side elevation:

a sample supporting stage which can be translated in "X", "Y" or "Z" directions as well as rotated about "X", "Y" and optionally "Z" axes;

vertically above said stage there being a first beam splitter means, a lens and a first camera means for providing a view of a portion of the surface of said sample, said first beam splitter means optionally having positioned on a lower surface thereof light emitting means for providing light to the surface of said sample;

laterally with respect to said first beam splitter means there being a reflection means;

vertically above said reflection means there being a second beam splitter;

vertically above said second beam splitter there being a second camera means and laterally with respect to said second beam splitter, there being sequentially a lens and an essentially point source of electromagnetic radiation;

said first and second camera means each having associated therewith display means;

said system further comprising an ellipsometer polarization state generator to cause, and a polarization stage detector to monitor, a beam of electromagnetic radiation which in use impinges on said monitored location on said surface of said sample at an oblique angle thereto;

such that in use said first camera means and its associated display means provide a view of at least a portion of the surface of a sample utilizing light provided by said light emitting means for providing light to the surface of said sample positioned on said lower surface of said first beam splitter, and said essentially point source of electromagnetic radiation provides electromagnetic radiation to the surface of said sample via said second beam splitter, said reflective means and said first beam splitter;

and said sample supporting stage is caused to be translated in any of said "X", "Y" and "Z" directions as well as rotated about said "X", "Y" and optionally "Z" axes which are necessary to cause an interrogating beam of electromagnetic radiation provided by said essentially point source of electromagnetic radiation to reflect from the surface of said sample, proceed back through said first beam splitter means, reflect from said reflective means, pass through said second beam splitter means, enter said second camera means and cause an image on the display means associated therewith which indicates that the monitored location on the sample surface is oriented so as to face substantially vertically;

the purpose being to align said sample surface to assure that said beam of electromagnetic radiation provided to said monitored location on the surface of said sample at an oblique angle approaches said surface at known intended angle of incidence and plane of incidnce orientation, rather than at an angle of incidence and plane of incidence orientation which is modified by surface irregularities or non-flat samples;

said system being functionally characterized by:

a first source of a first beam of electromagnetic radiation in functional combination with a multi-element alignment detector comprised of at least two detector elements surrounding a hole therethrough;

said first source of a first beam of electromagnetic radiation being oriented so as to provide a first beam of electromagnetic radiation through said hole in said multi-element alignment detector such that when said first beam of electromagnetic radiation is directed substantially along a normal to a surface of said sample surface via said hole in said multi-element alignment detector, substantially equal amounts of electromagnetic radiation enter each of the detector elements of said multi-element alignment detector;

said first beam of electromagnetic radiation being oriented at a known angle with respect to said beam of electromagnetic radiation provided to said monitored location on the surface of said sample at an oblique angle.